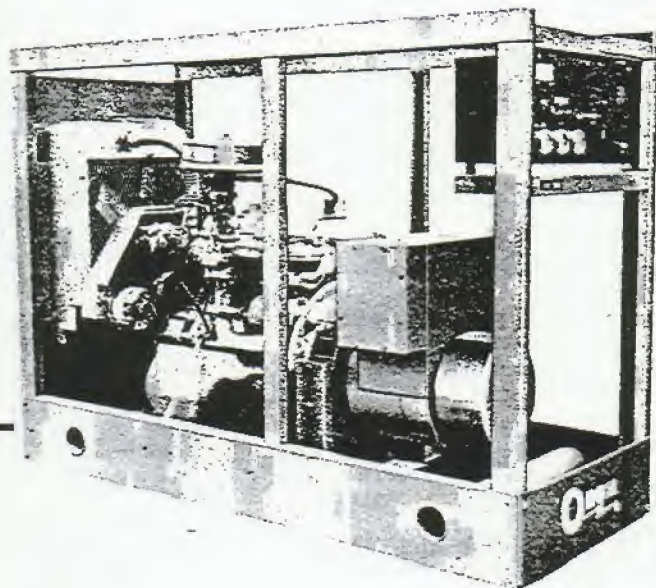


Onan

Operators Manual

SK GenSets



Safety Precautions

Before operating the generator set, read the Operator's Manual and become familiar with it and your equipment. **Safe and efficient operation can be achieved only if the equipment is properly operated and maintained.** Many accidents are caused by failure to follow fundamental rules and precautions.

The following symbols, found throughout this manual, alert you to potentially dangerous conditions to the operator, service personnel, or the equipment.

⚠ DANGER *This symbol warns of immediate hazards which will result in severe personal injury or death.*

⚠ WARNING *This symbol refers to a hazard or unsafe practice which can result in severe personal injury or death.*

⚠ CAUTION *This symbol refers to a hazard or unsafe practice which can result in personal injury or product or property damage.*

FUEL AND FUMES ARE FLAMMABLE. Fire and explosion can result from improper practices.

- DO NOT fill fuel tanks while engine is running, unless tanks are outside the engine compartment. Fuel contact with hot engine or exhaust is a potential fire hazard.
- DO NOT SMOKE OR ALLOW AN OPEN FLAME near the generator set or fuel tank. Internal combustion engine fuels are highly flammable.
- Fuel lines must be adequately secured and free of leaks. Fuel connection at the engine should be made with an approved flexible line. Do not use copper piping on flexible lines as copper will work harden and become brittle.
- Be sure all fuel supplies have a positive shutoff valve.
- DO NOT SMOKE while servicing batteries. Lead acid batteries emit a highly explosive hydrogen gas that can be ignited by electrical arcing or by smoking.

EXHAUST GASES ARE DEADLY

- Provide an adequate exhaust system to properly expel discharged gases. Inspect exhaust system daily for leaks per the maintenance schedule. Ensure that exhaust manifolds are secure and not warped. Do not use exhaust gases to heat a compartment.
- Be sure the unit is well ventilated.

MOVING PARTS CAN CAUSE SEVERE PERSONAL INJURY OR DEATH

- Coolants under pressure have a higher boiling point than water. DO NOT open a radiator or heat exchanger pressure cap while the engine is running. Bleed the system pressure first.

- Keep your hands away from moving parts.
- Before starting work on the generator set, disconnect batteries. This will prevent accidental starting.
- Make sure that fasteners on the generator set are secure. Tighten supports and clamps, keep guards in position over fans, drive belts, etc.
- Do not wear loose clothing in the vicinity of moving parts, or jewelry while working on electrical equipment. Loose clothing and jewelry can become caught in moving parts. Jewelry can short out electrical contacts and cause shock or burning.
- If adjustment *must* be made while the unit is running, use extreme caution around hot manifolds, moving parts, etc.

ELECTRICAL SHOCK CAN CAUSE SEVERE PERSONAL INJURY OR DEATH

- Remove electric power before removing protective shields or touching electrical equipment. Use rubber insulative mats placed on dry wood platforms over floors that are metal or concrete when around electrical equipment. Do not wear damp clothing (particularly wet shoes) or allow skin surfaces to be damp when handling electrical equipment.
- Use extreme caution when working on electrical components. High voltages cause injury or death. DO NOT tamper with interlocks.
- Follow all state and local electrical codes. Have all electrical installations performed by a qualified licensed electrician. Tag open switches to avoid accidental closure.
- DO NOT CONNECT GENERATOR SET DIRECTLY TO ANY BUILDING ELECTRICAL SYSTEM. Hazardous voltages can flow from the generator set into the utility line. This creates a potential for electrocution or property damage. Connect only through an approved isolation switch or an approved paralleling device.

GENERAL SAFETY PRECAUTIONS

- Provide appropriate fire extinguishers and install them in convenient locations. Consult your local fire department for the correct type of extinguisher to use. Do not use foam on electrical fires. Use extinguisher rated ABC by NFPA.
- Make sure that rags are not left on or near the engine.
- Remove all unnecessary grease and oil from the unit. Accumulated grease and oil can cause overheating and engine damage which present a potential fire hazard.
- Keep your generator set and the surrounding area clean and free from obstructions. Remove any debris from set and keep the floor clean and dry.
- Do not work on this equipment when mentally or physically fatigued, or after consuming any alcohol or drug that makes the operation of equipment safe.

Important Safety Precautions

Read and observe these safety precautions when using or working on electric generators, engines and related equipment. Also read and follow the literature provided with the equipment.

Proper operation and maintenance are critical to performance and safety. Electricity, fuel, exhaust, moving parts and batteries present hazards that can cause severe personal injury or death.

FUEL, ENGINE OIL, AND FUMES ARE FLAMMABLE AND TOXIC

Fire, explosion, and personal injury can result from improper practices.

- Used engine oil, and benzene and lead, found in some gasoline, have been identified by government agencies as causing cancer or reproductive toxicity. When checking, draining or adding fuel or oil, do not ingest, breathe the fumes, or contact gasoline or used oil.
- Do not fill tanks with engine running. Do not smoke around the area. Wipe up oil or fuel spills. Do not leave rags in engine compartment or on equipment. Keep this and surrounding area clean.
- Inspect fuel system before each operation and periodically while running.
- Equip fuel supply with a positive fuel shutoff.
- Do not store or transport equipment with fuel in tank.
- Keep an ABC-rated fire extinguisher available near equipment and adjacent areas for use on all types of fires except alcohol.
- Unless provided with equipment or noted otherwise in installation manual, fuel lines must be copper or steel, secured, free of leaks and separated or shielded from electrical wiring.
- Use approved, non-conductive flexible fuel hose for fuel connections. Do not use copper tubing as a flexible connection. It will work-harden and break.

EXHAUST GAS IS DEADLY

- Engine exhaust contains carbon monoxide (CO), an odorless, invisible, poisonous gas. Learn the symptoms of CO poisoning.
- Never sleep in a vessel, vehicle, or room with a genset or engine running unless the area is equipped with an operating CO detector with an audible alarm.
- Each time the engine or genset is started, or at least every day, thoroughly inspect the exhaust system. Shut down the unit and repair leaks immediately.

- Warning: Engine exhaust is known to the State of California to cause cancer, birth defects and other reproductive harm.

Make sure exhaust is properly ventilated.

- Vessel bilge must have an operating power exhaust.
- Vehicle exhaust system must extend beyond vehicle perimeter and not near windows, doors or vents.
- Do not use engine or genset cooling air to heat an area.
- Do not operate engine/genset in enclosed area without ample fresh air ventilation.
- Expel exhaust away from enclosed, sheltered, or occupied areas.
- Make sure exhaust system components are securely fastened and not warped.

MOVING PARTS CAN CAUSE SEVERE PERSONAL INJURY OR DEATH

- Do not remove any guards or covers with the equipment running.
- Keep hands, clothing, hair, and jewelry away from moving parts.
- Before performing any maintenance, disconnect battery (negative [-] cable first) to prevent accidental starting.
- Make sure fasteners and joints are secure. Tighten supports and clamps, keep guards in position over fans, drive belts, etc.
- If adjustments must be made while equipment is running, use extreme caution around hot manifolds and moving parts, etc. Wear safety glasses and protective clothing.

BATTERY GAS IS EXPLOSIVE

- Wear safety glasses and do not smoke while servicing batteries.
- Always disconnect battery negative (-) lead first and reconnect it last. Make sure you connect battery correctly. A direct short across battery terminals can cause an explosion. Do not smoke while servicing batteries. Hydrogen gas given off during charging is explosive.
- Do not disconnect or connect battery cables if fuel vapors are present. Ventilate the area thoroughly.

DO NOT OPERATE IN FLAMMABLE AND EXPLOSIVE ENVIRONMENTS

Flammable vapor can be ignited by equipment operation or cause a diesel engine to overspeed and become difficult to stop, resulting in possible fire, explosion, severe personal injury and death. **Do not operate diesel equipment where a flammable vapor environment can be created by fuel spill, leak, etc., unless equipped with an automatic safety device to block the air intake and stop the engine.**

HOT COOLANT CAN CAUSE SEVERE PERSONAL INJURY

- Hot coolant is under pressure. Do not loosen the coolant pressure cap while the engine is hot. Let the engine cool before opening the pressure cap.

ELECTRICAL SHOCK CAN CAUSE SEVERE PERSONAL INJURY OR DEATH

- Do not service control panel or engine with unit running. High voltages are present. Work that must be done while unit is running should be done only by qualified service personnel.
- Do not connect the generator set to the public utility or to any other electrical power system. Electrocutation can occur at a remote site where line or equipment repairs are being made. An approved transfer switch must be used if more than one power source is connected.
- Disconnect starting battery (negative [-] cable first) before removing protective shields or touching electrical equipment. Use insulative mats placed on dry wood platforms. Do not wear jewelry, damp clothing or allow skin surface to be damp when handling electrical equipment.
- Use insulated tools. Do not tamper with interlocks.
- Follow all applicable state and local electrical codes. Have all electrical installations performed by a qualified licensed electrician. Tag open switches to avoid accidental closure.
- With transfer switches, keep cabinet closed and locked. Only authorized personnel should have cabinet or operational keys. Due to serious shock hazard from high voltages within cabinet, all service and adjustments must be performed by an electrician or authorized service representative.

If the cabinet must be opened for any reason:

1. Move genset operation switch or Stop/Auto/Handcrank switch (whichever applies) to Stop.
2. Disconnect genset batteries (negative [-] lead first).
3. Remove AC power to automatic transfer switch. If instructions require otherwise, use extreme caution due to shock hazard.

MEDIUM VOLTAGE GENERATOR SETS (601V TO 15kV)

- Medium voltage acts differently than low voltage. Special equipment and training are required to work on or around medium voltage equipment. Operation and maintenance must be done only by persons trained and qualified to work on such devices. Improper use or procedures will result in severe personal injury or death.
- Do not work on energized equipment. Unauthorized personnel must not be permitted near energized equipment. Induced voltage remains even after equipment is disconnected from the power source. Plan maintenance with authorized personnel so equipment can be de-energized and safely grounded.

GENERAL SAFETY PRECAUTIONS

- Do not work on equipment when mentally or physically fatigued or after consuming alcohol or drugs.
- Carefully follow all applicable local, state and federal codes.
- Never step on equipment (as when entering or leaving the engine compartment). It can stress and break unit components, possibly resulting in dangerous operating conditions from leaking fuel, leaking exhaust fumes, etc.
- Keep equipment and area clean. Oil, grease, dirt, or stowed gear can cause fire or damage equipment by restricting airflow.
- Equipment owners and operators are solely responsible for operating equipment safely. Contact your authorized Onan/Cummins dealer or distributor for more information.

KEEP THIS DOCUMENT NEAR EQUIPMENT FOR EASY REFERENCE.

Table Of Contents

SAFETY PRECAUTIONS	Inside Cover
INTRODUCTION	2
SPECIFICATIONS	3
DESCRIPTION	4
General	4
Engine	4
AC Generator	4
Control Panel	4
Optional Equipment	4
Control Panel Interior	6
Engine Sensors	7
INSTALLATION	8
General	8
Location	8
Mounting	8
Ventilation	8
Cooling System	10
Fuel System	10
Exhaust System	11
Electrical System	12
OPERATION	17
General	17
Prestart Servicing	17
Starting	18
Stopping	19
No Load Operation	19
Exercise Period	19
High Altitude	19
High Temperatures	19
Low Temperatures	19
Out Of Service Protection	19
Battery, Hot Location	19
Troubleshooting Charts, Engine Shutdown System	20
MAINTENANCE	22
General	22
Engine	23
AC Generator	27

Introduction

FOREWORD

This manual is applicable to the SK series electric generating set, consisting of an ONAN YD generator, driven by a Chrysler HB-225 gas/gasoline engine. Information is provided on installation, operation, troubleshooting, and general maintenance of the set. This manual should be used in conjunction with the Chrysler engine manual, as your engine may have variations due to optional equipment available.

Where applicable, metric equivalents appear in parentheses following the U.S. customary units.

MODEL IDENTIFICATION

Identify your model by referring to the MODEL AND SPECIFICATION NO. as shown on the Onan nameplate. Electrical characteristics are shown on the lower portion of the nameplate.

When contacting a dealer or the factory regarding the set, always mention the complete Model, Spec. No. and Serial No. as given on the Onan nameplate. This information is necessary to properly identify your unit. Refer to the engine nameplate when requesting information from its manufacturer. The Onan nameplate is located on the right side of the generator; the Chrysler identification plate is on the right side of the engine on the cylinder head.

Left and right sides are considered when viewed from the engine or front end of the generator set.

⚠ WARNING

ONAN RECOMMENDS THAT ALL SERVICE INCLUDING INSTALLATION OF REPLACEMENT PARTS ONLY BE DONE BY PERSONS QUALIFIED TO PERFORM ELECTRICAL AND/OR MECHANICAL SERVICE. FROM THE STANDPOINT OF POSSIBLE INJURY AND/OR EQUIPMENT DAMAGE IT IS IMPERATIVE THAT THE SERVICE PERSON BE QUALIFIED.

⚠ WARNING

EXHAUST GAS IS DEADLY!

Exhaust gases contain carbon monoxide, an odorless and colorless gas. Carbon monoxide is poisonous and can cause unconsciousness and death. Symptoms of carbon monoxide poisoning can include:

- Dizziness
- Nausea
- Headache
- Weakness and Sleepiness
- Throbbing in Temples
- Muscular Twitching
- Vomiting
- Inability to Think Coherently

IF YOU OR ANYONE ELSE EXPERIENCE ANY OF THESE SYMPTOMS, GET OUT INTO THE FRESH AIR IMMEDIATELY. If symptoms persist, seek medical attention. Shut down the unit and do not operate until it has been inspected and repaired.

Protection against carbon monoxide inhalation includes proper installation and regular, frequent visual and audible inspections of the complete exhaust system.

Specifications

ENGINE DETAILS

Engine Manufacturer	Chrysler
Engine Series	HB-225
Number of Cylinders	6
Displacement	225-in ³ (3.68 litres)
Power @ 1800 r/min	55 BHP (41 kW)
Compression Ratio	8.2:1
Bore	3.4 (86.4 mm)
Stroke	4.125 (104.8 mm)
Fuel	Gas/Gaso/LPG
Battery Voltage	12
Battery Group Size (One, 360 Amp Cranking Performance @ 0°F (-18°C))	60
Starting Method	Solenoid Shift
Governor Regulation	5% Max. No Load-Full Load
Battery Charging Current	35-Amperes

GENERATOR DETAILS

Type	YD15 60 Hz
Rating	
60 Hertz Continuous Standby (Gasoline/LPG)	30.0 kW (37.5 kVA)
60 Hertz Continuous Standby (Natural Gas)	25.0 kW (31.25 kVA)
AC Voltage Regulation	+2%
60 Hertz-r/min	1800
Output Rating	0.8 PF
AC Frequency Regulation	3 Hz

CAPACITIES AND REQUIREMENTS

Cooling System, Engine and Radiator	18-quarts (17 litres)
Engine Oil Capacity (Filter, Lines, and Crankcase)	6-quarts (5.7 litres)
Exhaust Connection (inches pipe thread)	2

AIR REQUIREMENTS (1800 r/min)

Engine Combustion	100 cfm (2.8 m ³ /min)
Radiator Cooled Engine	5300 cfm (150 m ³ /min)
Total for Radiator Cooled Model	5400 cfm (152.8 m ³ /min)
Alternator Cooling Air	450 cfm (12.7 m ³ /min)
Fuel Consumption at Rated Load	
Gasoline (Regular)	4.4 gal/hr (16.7 litres/hr)
Natural Gas (1000 BTU/ft ³ (37.25 MJ/m ³)	402 ft ³ /hr (11.4 m ³ /hr)
LPG (2500 BTU/ft ³ (93.1 MJ/m ³)	211 ft ³ /hr (5.97 m ³ /hr)

GENERAL

Height	51.25-inches (1.302 m)
Width	29.23-inches (0.742 m)
Length	72.62-inches (1.845 m)
Approximate Weight (Mass)	1364-lb (618.7 kg)

Description

GENERAL

An ONAN SK series electric generating set is a complete unit consisting of an engine driven AC generator, with controls and accessories as ordered.

ENGINE

The engine on the SK is a Chrysler HB-225 as described in the engine manual. Basic measurements and requirements will be found in the SPECIFICATIONS section of this manual. For operation, maintenance and service information, consult the Chrysler manual.

AC GENERATOR

The generator is an ONAN YD 12 lead, 4-pole, revolving field, reconnectable brushless unit. The main rotor is attached directly to the engine flywheel, therefore generator output frequency is determined by engine speed. The engine runs at 1800 r/min. to achieve an output frequency of 60 Hz.

Excitation is achieved from a voltage induced in a stator winding from residual magnetism in the rotor. This voltage is applied to the voltage regulator where it is compared with a reference voltage, rectified, and applied to the field of the exciter. Voltage induced in the exciter rotor is rectified and applied to the generator rotor. The rotor in turn induces a voltage in the generator stator which is applied to the load.

CONTROL PANEL

The standard control panel may be mounted in the rear or either side of the generating set frame work. Normally the panel will be mounted in the rear by Onan, however, the operator may change the panel location to either side.

The following is a brief description of the standard controls and instruments located on the face of the control panel:

DC Panel

Oil Pressure Gauge: Indicates lubricating oil pressure (wired to a sensor unit located on the engine).

Water Temperature Gauge: Indicates temperature of engine coolant (wired to a sensor unit on the engine).

Battery Ammeter: Indicates battery charging current.

Running Time Meter: Registers total unit run time in hours to the 1/10th. Time is accumulative; meter cannot be reset. Use meter to keep a record for periodic servicing.

Run-Stop-Remote Switch: Starts and stops unit locally or allows operation from a remote location.

Reset Switch: Manual reset for engine monitor after an engine shutdown.

Fault Light: Indicates a "Fault" in engine operation.

AC Panel

AC Voltmeter: Indicates generator output voltage. Dual range instrument, scale in use shown on indicator light.

Voltmeter-Ammeter Phase Selector Switch: Selects the phases of the generator output to be monitored by the AC voltmeter and the optional AC ammeter.

Exciter Circuit Breaker: Protects the generator exciter and regulator from overload in the event of certain exciter or regulator malfunctions.

Voltage Adjust Rheostat: Provides approximately plus or minus five percent manual adjustment of rated output voltage.

OPTIONAL EQUIPMENT

DC Panel

Warning Lights: Eliminates the single "Fault" light and substitutes five indicator lights to give warning of:

- Overcrank (failure to start)
- Overspeed
- Low oil pressure
- High engine temperature
- Low engine temperature

Operation of these lights will be discussed in the control panel interior section of this manual.

AC Panel

AC Ammeter: Indicates generator output current. Dual range instrument, scale in use is shown on indicator light.

Frequency Meter: Indicates generator frequency in hertz. It can be used to check engine speed since every 30 r/min. equals one hertz.

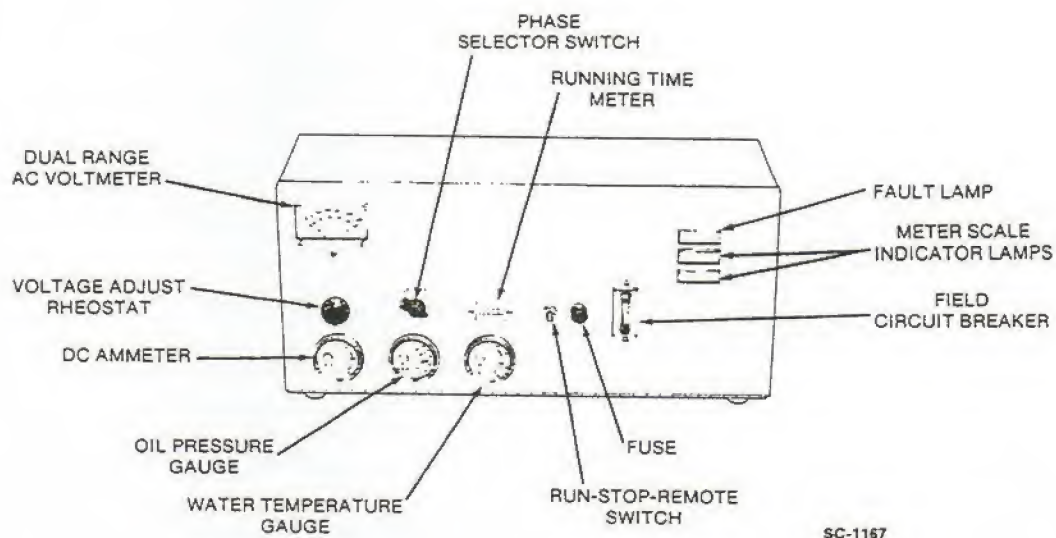


FIGURE 1. STANDARD CONTROL PANEL

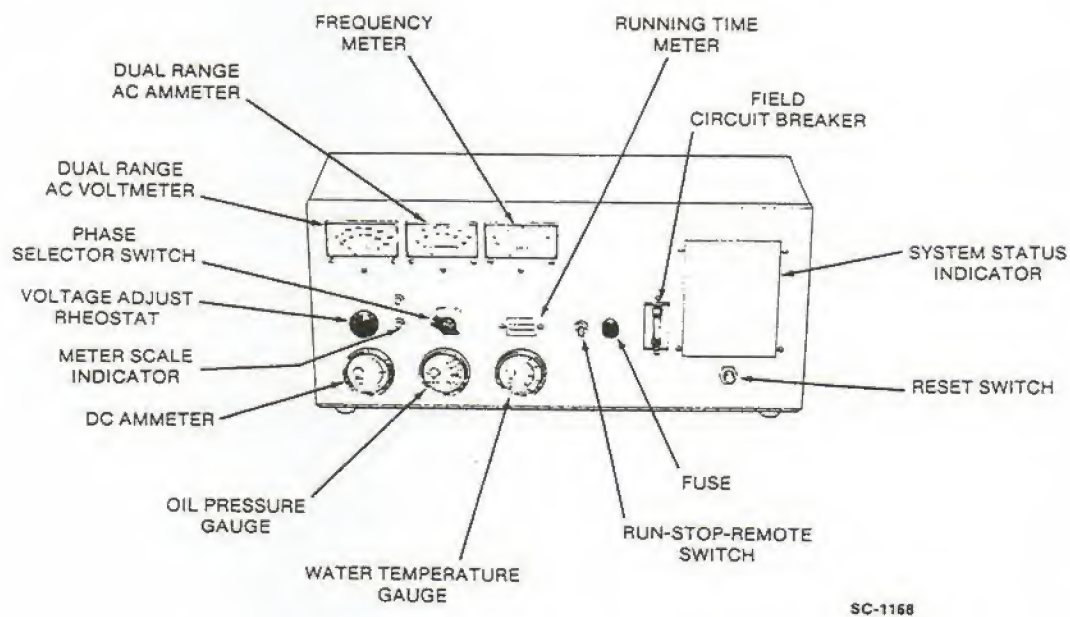


FIGURE 2. OPTIONAL CONTROL PANEL

CONTROL PANEL INTERIOR

The only equipment that will be discussed in this section will be that which the operator may have reason to adjust or inspect for service.

Terminal Boards (TB) 21 and 22: When the generator has been reconnected for a different voltage the reference voltage that the voltage regulator senses must also be changed. This is accomplished by connecting wire W12 from TB21-63 to TB22-H3, H4, or H5 per Figure 14.

Voltage Regulator: Solid state unit, consisting of printed circuit board VR21, a SCR bridge CR21, with a commutating reactor L21 and reference transformer T21 are located in the control panel as part of the voltage regulator system. The AC output from the generator is controlled at the predetermined voltage regardless of load; regulation is plus or minus 2% from no load to full load at a 0.8 P.F.

Engine Monitor and Shutdown modules: Printed circuit plug-in modules provide the following functions:

1. A 75 second cranking period.
2. Approximately a 10.0 second time delay for oil pressure build up.
3. An external alarm contact to light the fault lamp and shutdown the set for malfunctions such as:
 - a. Overcrank- failure to start after the 75 second cranking period.
 - b. Low oil pressure-14 psi. (96.5 kPa).
 - c. Overspeed - approximately 2100 r/min.
 - d. High engine temperature - 215° F (102° C).

On standard control panels all four alarms are wired into one common fault lamp. Diagnostic light emitting diodes for overcrank, low oil pressure, and high engine temperature are provided on the front of the module cover panel, inside the control panel. If an engine malfunction shutdown occurs, (fault lamp illuminated), and none of the diagnostic diodes are illuminated, then the shutdown is due to an overspeed condition.

On optional control panels a fault lamp is provided for each malfunction shutdown. A fifth fault lamp is also provided for low engine temperature, although there is not an engine shutdown associated with it. See Table 1.

CAUTION

High Engine Temperature Cutoff will shut down engine in an overheat condition only if coolant level is sufficiently high to physically contact shutdown switch. Loss of coolant will allow engine to overheat without protection of shutdown device, thereby causing severe damage to the engine. Adequate engine coolant levels must be maintained to ensure operational shutdown protection capability of engine cooling system.

Optional Modules

Start Disconnect module: Used in conjunction with a magnetic sensing device that senses and sends engine speed to the Start Disconnect module and the overspeed circuit. This plug-in module operates at approximately 100 r/min. above maximum cranking speed to prevent energizing the starter while the engine is running.

Cycle Cranker: Plug-in module replaces the standard cranking circuit. This module provides a 15-second crank time and a 10-second rest period alternately for three ON and two OFF cycles in 65 seconds. If the engine does not start within 75 seconds the engine monitor lights a fault lamp and disables the cranking circuit.

Time Delay Start/Stop module: Plug-in module that is used only in remote start applications. Provides 1-10 seconds time delay on starting and 30 seconds to 5 minutes time delay on stopping. The delay periods are adjustable on the module front.

Switches

Cycle-Standard Cranker Switch: This switch is found only in the single fault lamp control panels. The switch will normally be in the Standard Cranker position unless the optional cycle cranker module is installed and is to be used. When the cycle cranker module is used the switch is positioned to the Cycle Cranker position, disabling the standard cranker circuit.

Pre-Alarm-Shutdown Switch: When an additional coolant temperature and oil pressure switch are installed, the pre-alarm position enables the operator to provide himself with an advance warning of high engine temperature and low oil pressure before the parameters reach the shutdown set point.

Time Delay Bypass switch: When the time delay start/stop module is installed and the remote start feature is wired in, the time delay position permits the operator to install a time delay on the starting and stopping of the generating set.

TABLE 1. FAULT LAMP OPTIONS

SYSTEM	FAULT	FAULT LAMP	STOP ENGINE	EXTERNAL ALARM
STANDARD SINGLE LIGHT	Overcrank	x	x	x
	Overspeed	x	x	x
	Low Oil Pressure	x	x	x
	High Engine Temperature	x	x	x
5 LIGHT	Overcrank	x	x	x
	Overspeed	x	x	x
	Low Oil Pressure	x	x	x
	High Engine Temperature	x	x	x
	Low Engine Temperature	x		
5 LIGHT PRE-ALARM	Overcrank	x	x	x
	Overspeed	x	x	x
	Pre Low Oil Pressure	x		x
	Low Oil Pressure	x	x	x
	Pre High Engine Temperature	x		x
	High Engine Temperature	x	x	x
	Low Engine Temperature	x		

ENGINE SENSORS

Resistance units and switches in the engine temperature and oil pressure monitoring and shutdown systems are sealed units and are not repairable. See Figure 3.

When changing a sensor, do not substitute, use recommended replacement parts. Resistance units are matched to the gauge they supply. Cut-off switches are close tolerance parts, made for a specific application.

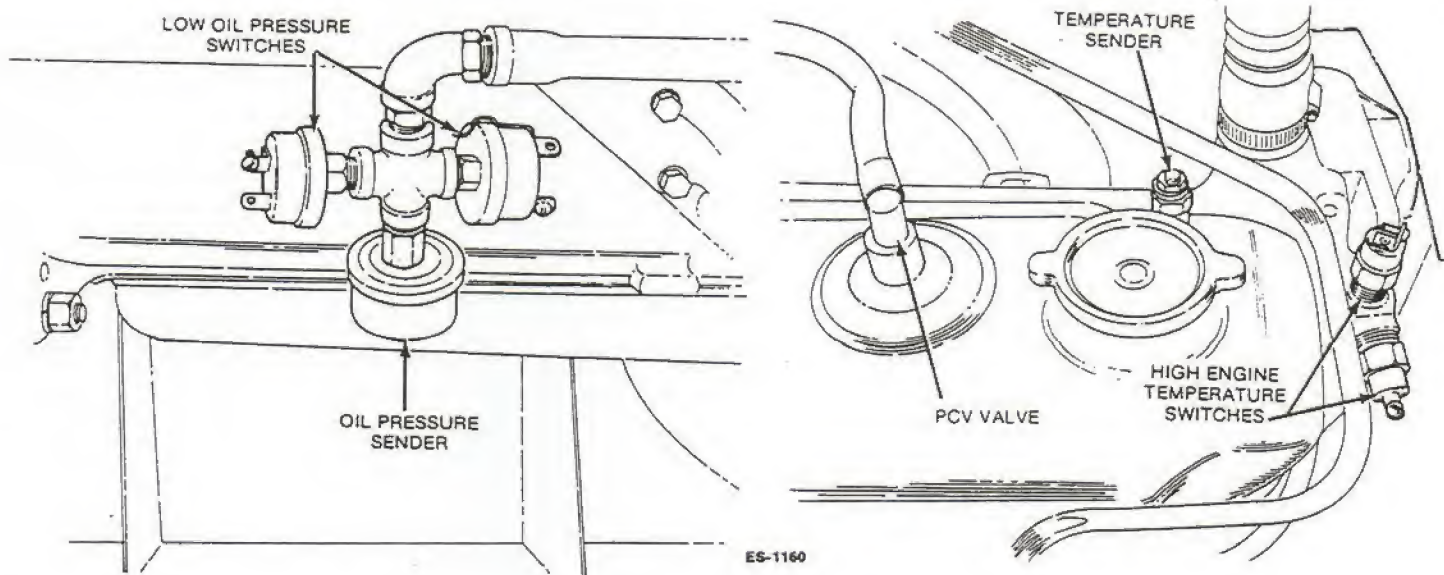


FIGURE 3. ENGINE SENSORS

Installation

GENERAL

Installations must be considered individually. Use these instructions as a general guide. All installations must meet regulations of state and local building codes, fire ordinances, etc., which may affect installation details.

Requirements to be considered prior to installation:

1. Level mounting surface.
2. Adequate cooling air.
3. Adequate fresh induction air.
4. Discharge of circulated air.
5. Discharge of exhaust gases.
6. Electrical connections.
7. Fuel installation.
8. Water supply (city water cooling).
9. Accessibility for operation and servicing.
10. Vibration isolation.
11. Noise levels.

For specific installation information refer to Onan technical bulletin T-030, INSTALLATION INFORMATION FOR ONAN LIQUID-COOLED ELECTRIC GENERATING SETS.

LOCATION

Provide a location that is protected from the weather and is dry, clean, dust free and well ventilated. If practical, install inside a heated building for protection from extreme weather conditions. See Figure 4.

MOUNTING

Generator sets are mounted on a rigid skid base which provides proper support. The engine-generator assembly is isolated from the skid base by rubber mounts which provide adequate vibration isolation for normal installations. For installations where vibration control is critical, install additional spring-type isolators between skid base and foundation.

For convenience in general servicing and changing crankcase oil, mount set on raised pedestal at least 6-inches (152 mm) high.

VENTILATION

Generator sets create considerable heat which must be removed by proper ventilation. Outdoor installations rely on natural air circulation but indoor installations need properly sized and positioned vents for the required air flow. See *SPECIFICATIONS* for the air required to operate with rated load under normal conditions at 1800 r/min.

Radiator set cooling air travels from the rear of the set and is removed by a pusher fan which blows out through the radiator. Locate the air inlet to the rear of the set.

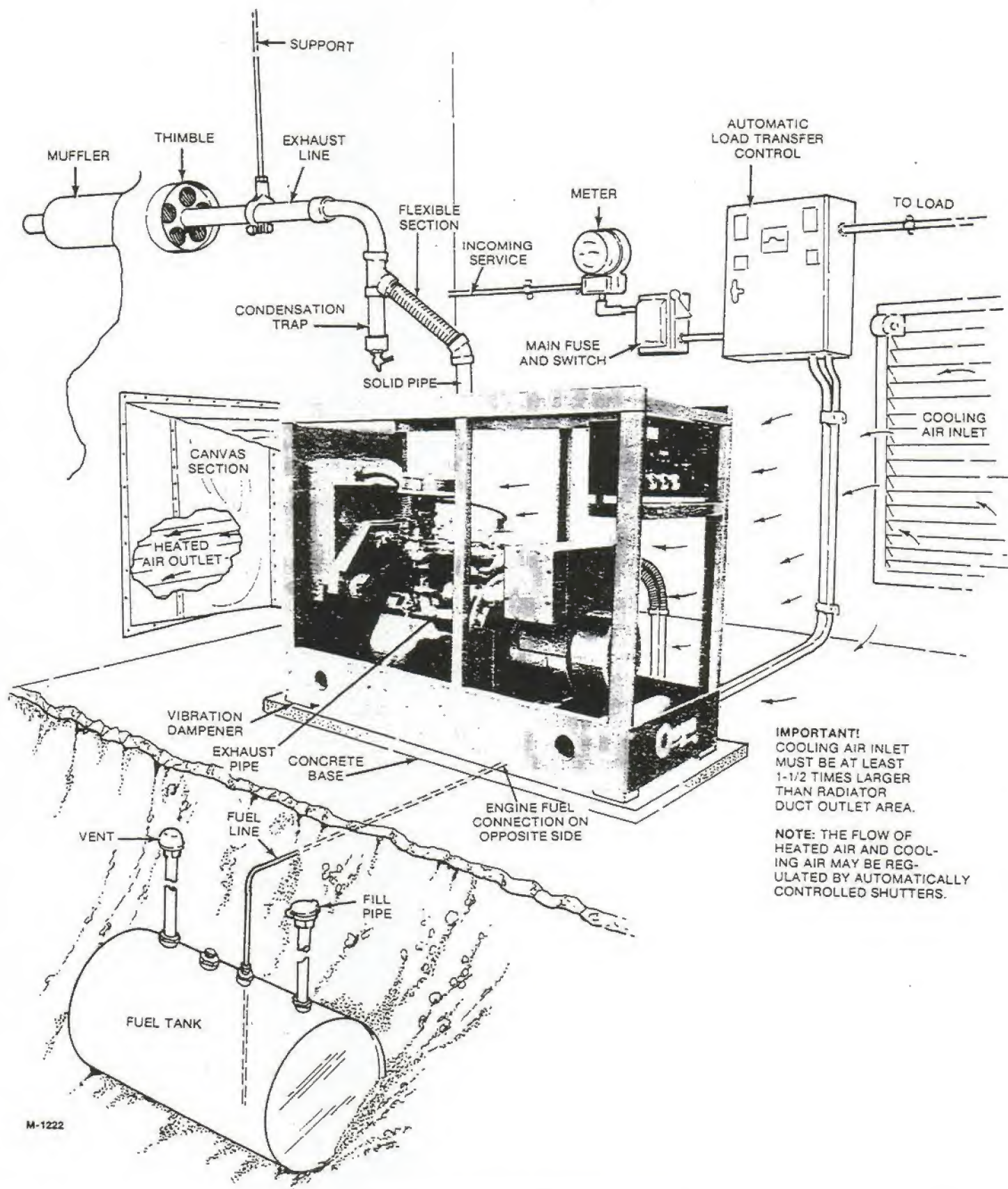
Locate the cooling air outlet directly in front of the radiator and as close as possible. The opening free area must be at least as large as the radiator-area. Length and shape of the air outlet duct should offer minimum restriction to air flow. Use a duct of canvas or sheet metal between the radiator and the air outlet opening. The duct prevents recirculation of heated air. Remove the radiator core guard prior to installing the duct.

For operation outside a building, a shelter housing with electrically operated louvers is available as an option. Transformers connected across the generator output supply current to the motors.

When the generator is operating, current in the transformers actuate the motors and open the louvers. The louvers are held open for the duration of the set operation, then are closed by return springs when the set is shut down.

City water cooled sets do not use the conventional radiator. A constantly changing water flow cools the engine. Sufficient air movement and fresh air must be available to properly cool the generator, disperse heat convected off the engine and support combustion in the engine.

Installations require an auxiliary fan (connected to operate only when the unit is running) of sufficient size to assure proper air circulation and evacuation of fumes.



M-1222

FIGURE 4. TYPICAL SK INSTALLATION

COOLING SYSTEM

Standard Radiator Cooling

This system uses a set mounted radiator and engine driven pusher type fan to cool engine water jacket. Air travels from the generator end of the set, across the engine and out through the radiator. An integral discharge duct adapter flange surrounds the radiator grille.

Water Jacket Heater

This option may be installed to keep engine coolant warm while engine is shut down. It heats and circulates the coolant within the engine, which reduces start-up time and engine wear caused by cold starts. It is electrically operated and thermostatically controlled.

Direct Flow Installation

With this system, a city or raw water cooling supply under pressure forces water directly into the engine, through the engine and to the outlet. An adjustable valve controls the incoming water flow rate to obtain correct engine water temperature, as measured at engine coolant water outlet while the generator set is operating under full load. A solenoid valve is coordinated with the generator set system to open during set operation.

CAUTION Restrict inlet water pressure to a maximum of 7 psi or 48.3 kPa, otherwise engine gaskets and seals will leak.

Raw water cooling is often undesirable because:

1. The water supply must be very clean or engine deposits will result.
2. A high temperature differential between the cold incoming water into the engine and warm discharged water can put damaging stresses on engine components (no overall uniform engine temperature).

Connections

The radiator cooled (standard) set does not require any external connections except as discussed under *Ventilation*. Allow clearance around the set for access to service the radiator and fan belts.

FUEL SYSTEM

Chrysler engines used on SK sets are designed to operate on gasoline (automotive "regular" grade), natural gas with a thermal rating of 1000 BTU/ft³ (37.25 MJ/m³), or liquefied petroleum gas (LPG) Propane at 2500 BTU/ft³ (93.13 MJ/m³).

WARNING

Attempting to weld on a fuel tank, empty or not, is extremely dangerous. Heat or sparks from welding may cause an explosion or fire and result in severe personal injury or death.

Connections

Before starting any type of fuel installation, ONAN recommends that all pertinent state and local codes be complied with, and the installation must be inspected before the unit is put in service.

Fuels under pressure (e.g. natural gas or LPG) must be controlled by a positive shut off valve, preferably automatic, in addition to any valve integral with the carburetor or gas regulator equipment.

Fuel lift should not exceed 6 feet (1.83 m). Horizontal distance between set and fuel tank should not exceed 50 feet (15 m). Use 3/8-inch tubing up to 25 feet (7.6 m), 1/2 inch up to 50 feet (15 m).

WARNING

The fuel system must meet applicable codes. Always use flexible tubing between engine and the fuel supply to avoid line failure and leaks due to vibration. Fuel leaks create fire and explosive hazards and waste fuel.

Optional Day Tank: The engine may be equipped with a one quart (0.9 litres) reservoir tank to replenish fuel lost from the carburetor by evaporation during shutdown (Figure 5). Connect a 5/16-inch return line between the reservoir upper side fitting (this fitting has a restricted orifice and must be used) and the main supply tank. Be sure the return line has a continuous drop to the main supply tank with no dip-and-rise where fuel could collect and form a vent seal. See that the top center opening of the tank is tightly plugged.

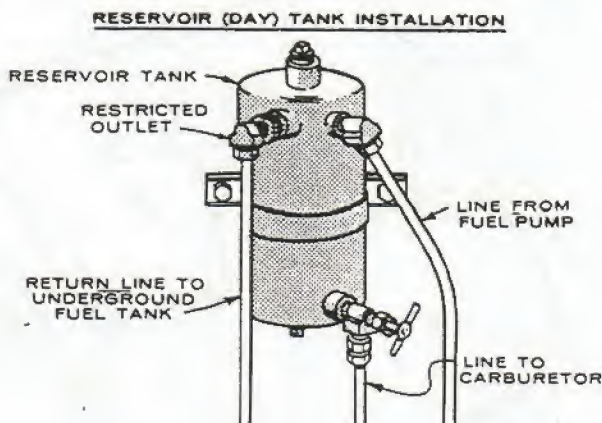


FIGURE 5. DAY TANK INSTALLATION

Natural or Manufactured Gas: On sets equipped with an Impco carburetor, gas pressure at the carburetor must be set at 3-ounces (1.3 kPa) gauge, or 5-inch (127 mm) water column, manometer, with the engine running at 1800 r/min on no load.

Thermac regulator is designed for a maximum line pressure of 6-ounces (2.6 kPa) gauge, or 10.38-inches (263.6 mm) water column, manometer.

If line pressure is excessive, install a suitable pressure reducing regulator. Be sure to comply with all local regulations such as:

- Recommended electric shutoff valve.
- Hand shutoff valve at the fuel source.
- Supply line filter.

Use a short length of approved flexible connection between the supply pipe and the set regulator inlet.

Combination Gas-Gasoline: Combination gas-gasoline sets are designed for normal operation on gas fuel, with provision for emergency operation on gasoline. Both gas and gaso procedures must be followed. A reservoir tank is sometimes provided, so a fuel return line may be necessary as described for gasoline fuel.

WARNING

Do not permit any flame, cigarette, or other igniter near the fuel system.

Propane gas is highly flammable and potentially explosive in confined spaces.

SAFETY PRECAUTIONS WHEN WORKING WITH LPG

- Be sure LPG tank shut-off valve is closed before disconnecting tank from system.
- Ignition switch must be in OFF position prior to disconnecting any electrical wires.
- Check fuel system regularly for leaks. Use soap to locate leaks and recheck with soap after repairing leaks.
- Keep a fire extinguisher handy for immediate use. A dry powder or carbon dioxide (CO₂) type is recommended.
- Never use LPG for cleaning parts.
- Do not use LPG near open flame. Work in a well ventilated area.

LPG is heavier than air and settles in low places.

EXHAUST SYSTEM

WARNING

Use extreme care during exhaust system installation to ensure a tight exhaust system. Exhaust gases are deadly.

Engine exhaust gas must be piped outside building or enclosure. Do not terminate exhaust pipe near inlet vents or combustible materials. An approved thimble must be used where exhaust pipes pass through walls or partitions (Figure 6). Build the thimble according to codes (see National Fire Protection Association bulletin, Volume 4, Section 211 on "Standards for Chimneys, Fireplaces and Vents").

Pitch exhaust pipes downward or install a condensation trap at the point where a rise in the exhaust system begins (Figure 7). Avoid sharp bends; use sweeping long radius elbows. Provide adequate support for mufflers and exhaust pipes. Shield or insulate exhaust lines if there is danger of personal contact. Allow at least 9 inches (230 mm) of clearance if the pipes run close to a combustible wall or partition. Use a pipe at least as large as the 2-inch pipe size outlet of the engine.

Suspend the pipe from the enclosure structure. Use a flexible section between the suspended pipe and a length of solid pipe on the engine (see Figure 4). Place muffler close to engine to reduce carbon fouling and condensation damage.

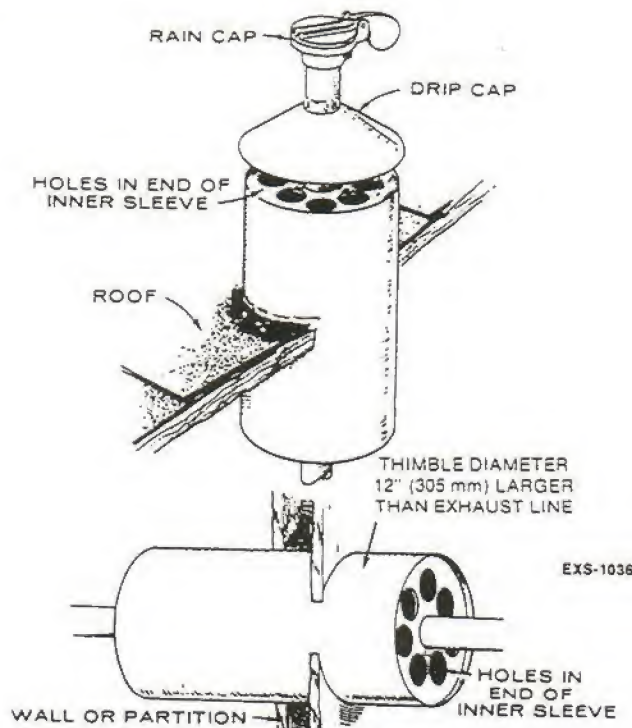


FIGURE 6. TYPICAL EXHAUST THIMBLE

A critical muffler recommended for this unit is sized for a 3-inch exhaust pipe. Maximum allowable length of pipe for this diameter is 128 feet (39 m). Table 2 lists lengths for other pipe diameters and equivalent lengths for fittings. Maximum permissible exhaust restriction (back pressure) is 1.8-inches (45.7 mm) Hg.

TABLE 2. MAXIMUM EXHAUST PIPE LENGTH WITH ONE CRITICAL MUFFLER

EXHAUST PIPE SIZE IN INCHES	MAX. LENGTH FEET (METRES)	EQUIVALENT PIPE LENGTH PER FITTING, FEET (METRES)			
		Standard Elbow	Long Radius Elbow	Medium Radius Elbow	Standard Tee
2.0	15 (5)	5.3 (1.62)	3.5 (1.07)	4.6 (1.40)	13 (3.96)
2.5	38 (12)	6.4 (1.95)	4.2 (1.28)	5.4 (1.64)	14 (4.27)
3.0	128 (40)	8.1 (2.47)	5.2 (1.58)	6.8 (2.07)	17 (5.18)
3.5	281 (87)	9.6 (2.93)	6 (1.83)	8 (2.44)	19 (5.79)

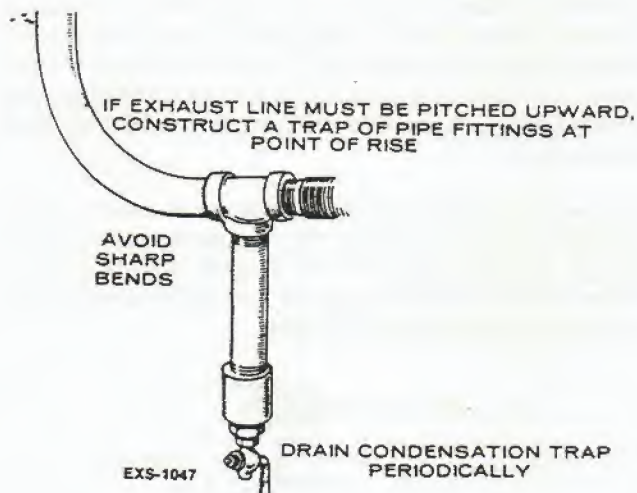


FIGURE 7. EXHAUST CONDENSATION TRAP

WARNING Do not use exhaust manifold heat to warm a room or compartment occupied by people. Leaking of harmful exhaust gases may result in personal injury or death.

ELECTRICAL SYSTEM

Battery Connection

The generator set requires one 12-volt battery (Figure 8) for a normal installation. (See *Specifications*.) Necessary battery cables are on unit. Service battery as necessary. Infrequent set use (as in emergency standby service) may allow battery to self-discharge to the point where it cannot start the unit. If installing an automatic transfer switch that has no built-in charge circuit, connect a separate trickle charger. Some Onan automatic transfer switches include such a battery charging circuit.

WARNING Do not smoke while servicing batteries. Explosive gases are emitted from batteries in operation. Ignition of these gases can cause severe personal injury.

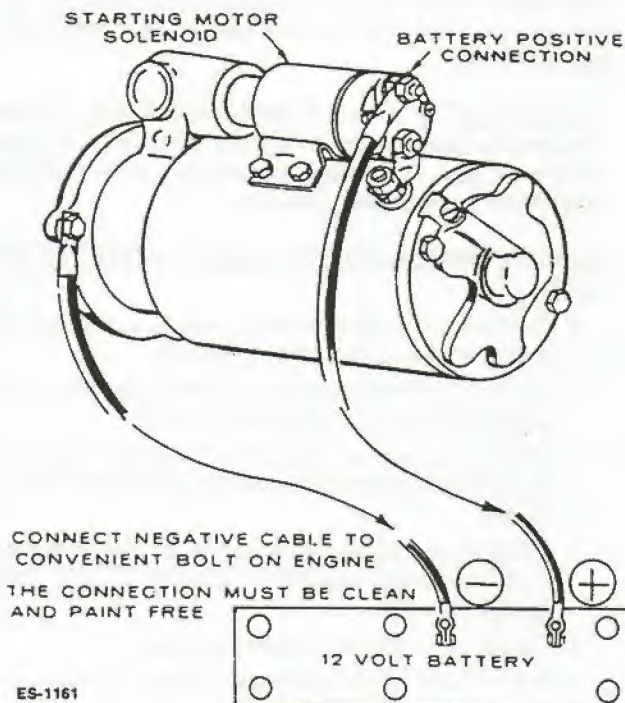
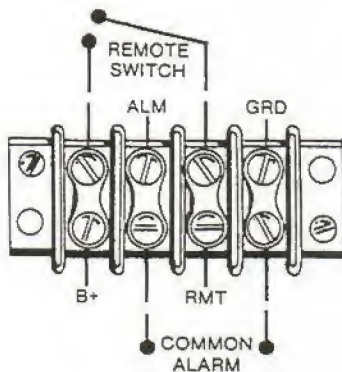


FIGURE 8. BATTERY CONNECTION

Remote Start-Stop Switch

Provision is made for addition of remote starting. This is accomplished on a 4 place terminal block situated on the chassis printed circuit board (Figure 9). Connect one or more remote switches across remote terminal and B+ terminal. If the distance between the set and remote station is less than 1000-feet (305 m), use No. 18 AWG wire; between 1000- and 2000-feet (305 m and 610 m), use No. 16 AWG wire.



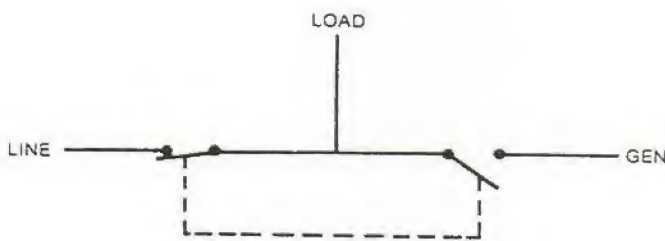
ES-1135

FIGURE 9. REMOTE START CONNECTION

Load Wire Connections

Most local regulations require that wiring connections be made by a licensed electrician and that the installation be inspected and approved before operation. All connections, wire sizes, etc. must conform to requirements of electrical codes in effect at the installation site.

If the installation is for standby service, a double throw transfer switch must always be used (Figure 10). Connect this switch (either automatic or manual) so that it is impossible for commercial power and generator current to be connected to the load at the same time. Instructions for connecting an automatic load transfer control are included with such equipment.



SC-1101

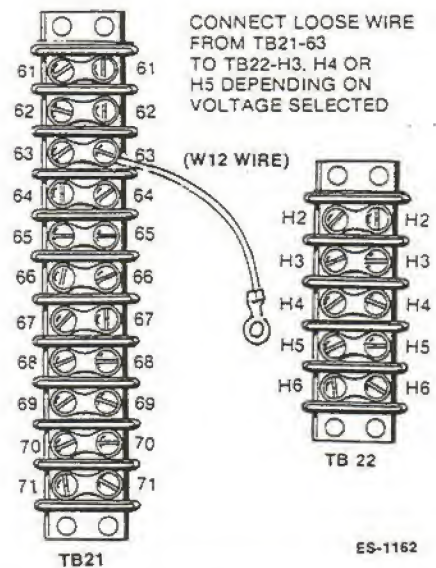
NOTE: SHOWN WITH LINE CONNECTED TO LOAD

FIGURE 10. LOAD TRANSFER SWITCH
(TYPICAL FUNCTION)

Control Box Connections: The factory ships these 12 lead generators with load connection wires NOT connected together in the control box. These 12 wires are labeled T1 through T12 and must be brought together before making load connections. Proceed as follows:

1. Remove either right, left or top panel from control box.
2. Connect wires together as shown on panel drawing and in Figure 12 according to voltage desired.
3. Open hinged control panel doors. Connect lead from TB21-63 to correct terminal on TB22 for voltage desired. See Figures 11 and 12. The terminals are labeled H3, H4, and H5.
4. Close front panel and secure with 1/4 turn fasteners.
5. Connect load wires to generator leads.

Preceding instructions do not apply to models designated Code 3 or 9X; this connection is made at the factory. The installer must only connect load wires.



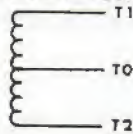
ES-1162

FIGURE 11. REFERENCE VOLTAGE CONNECTION

120/240 Volt, Single Phase, 12 Lead: Terminal connection L0 can be grounded (neutral) as shown in Figure 13. For 120 volts, connect the hot load wires to either the L1 or L2 connection. Connect the neutral load wire to the grounded L0 connection. Two 120 volt circuits are thus available, with not more than 1/3 the rated capacity of the set available on either circuit. If using both circuits, be sure to balance the load between them.

120/240 VOLT, 1 PHASE, 60 HERTZ

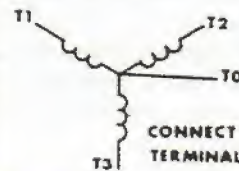
NAMEPLATE VOLTAGE CODE 3



CONNECT LEAD FROM
TERMINAL 63 TO H5

347/600 VOLT, 3 PHASE, 60 HERTZ

NAMEPLATE VOLTAGE CODE 9X



CONNECT LEAD FROM
TERMINAL 63 TO H5

+

THIS DIAGRAM APPLIES TO 12 LEAD GENERATORS ONLY

NAMEPLATE VOLTAGE CODE					VOLTAGE	PHASES	HERTZ	CONNECT LEAD FROM TERMINAL 63 TO:	GENERATOR CONNECTION	GENERATOR CONNECTION SCHEMATIC DIAGRAM	GENERATOR CONNECTION WIRING DIAGRAM (WITH CURRENT TRANSFORMERS WHEN USED)
VOLTAGE											
15	120/240	1	60	H5	DOUBLE DELTA						
15	120/240	3	60	H5		SERIES DELTA					
15	120/208 127/220 139/240	3	60	H3 H4 H5	PARALLEL WYE						
15	240/416 254/440 277/480	3	60	H3 H4 H5		SERIES WYE					

FIGURE 12. VOLTAGE CONNECTIONS

ES-1163

For 240 volts, connect one load wire to the L1 connection and the second load wire to the L2 connection. Terminal connection L0 is not used for 240 volt service.

Only 2/3 of rated current is available from this connection.

Figure 13 shows load connections for 120/240 voltage, single phase. The double delta connections are shown in Figure 12.

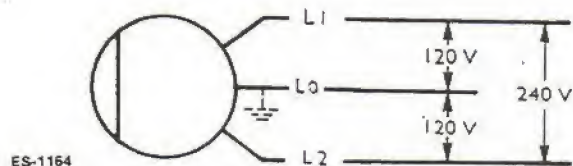


FIGURE 13. 120/240 V. 1-PHASE

120/240 Volt, 3 Phase, Delta Connected Set; 12 Lead:

The 3 phase Delta connected set is designed to supply 120 and 240 volt, 1 phase current and 240 volt, 3 phase current. For 3 phase operation, connect the three load wires to generator terminals L1, L2 and L3—one wire to each terminal. For 3 phase operation the L0 terminal is not used. See Figure 14.

For 120/240 volt, 1 phase, 3 wire operation, terminals L1 and L2 are the "hot" terminals. The L0 terminal is the neutral, which can be grounded if required. For 120 volt service, connect the black load wire to either the L1 or L2 terminal. Connect the neutral (white) wire to the L0 terminal. Two 120 volt circuits are available. Connect between any two 3-phase terminals for 240 volt 1-phase loads.

Any combination of 1 phase and 3 phase loading can be used at the same time as long as total current does not exceed the NAMEPLATE rating of the generator. If no 3 phase output is used, usable 1 phase output is 2/3 of 3 phase kVA.

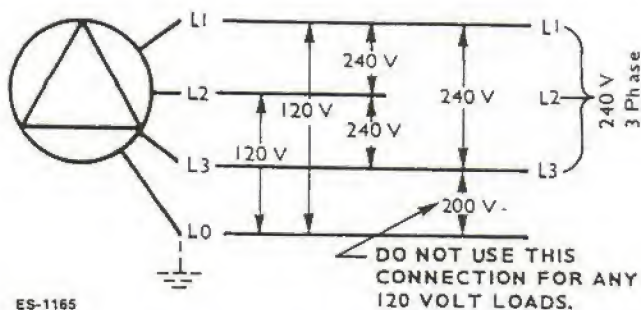


FIGURE 14. 120/240 V. 3-PHASE DELTA

3 Phase, Wye Connected Set: The 3 phase, 4 wire set produces line to neutral voltage and line to line voltage. Line to neutral voltage is the lower voltage as noted on the unit nameplate, line to line voltage is the higher nameplate voltage.

For 3 phase loads, connect separate load wires to each of the set terminals L1, L2 and L3. Single phase output of the higher nameplate voltage is obtained between any two 3 phase terminals (Figure 15).

The terminal marked L0 can be grounded. For 1 phase loads, connect the neutral (white) load wire to the L0 terminal. Connect the black load wire to any one of the other three terminals—L1, L2 or L3. Three separate 1 phase circuits are available, with not more than 1/3 the rated capacity of the set from any one circuit.

If using 1 phase and 3 phase current at the same time, use care to properly balance the 1 phase load, and not to exceed rated line current.

Figure 15 shows load connections for 120/208 voltage. Other voltages are available from either parallel wye or series wye illustration in Figure 12.

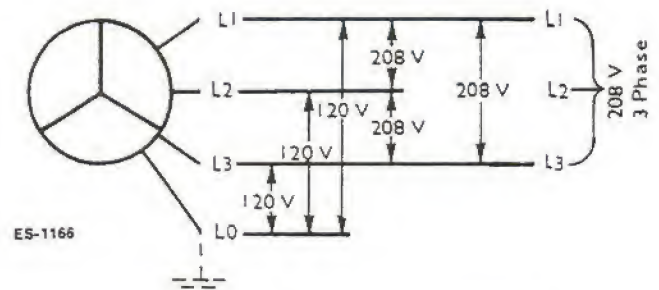
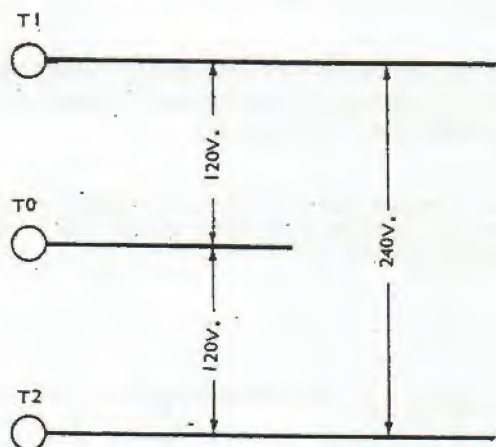


FIGURE 15. 120/208V. 3-PHASE WYE

120/240 Volt, 1 Phase, 3 Wire (3R Units): Terminal post T0 is the grounded (neutral) terminal. For 120 volt current, connect the "hot" load wire to either the T1 or T2 terminal. Connect the neutral load wire to the T0 terminal. Two 120 volt circuits are thus available, with not more than 1/2 the rated capacity of the set available on each circuit. Balance the load as closely as possible. See Figures 16 and 12.

For 240 volt current, connect one load wire to terminal T1 and the second load wire to terminal T2. Terminal T0 is not used for 240 volt service.

CAUTION *If using both 120 and 240 volt current at the same time, use care not to overload either circuit.*



ES-1167

FIGURE 16. 120/240 V. 1-PHASE (CODE 3)

Grounding

Typical requirements for bonding and grounding are given in the National Electrical Code, 1975, Article 250.

Periodic inspection is recommended, especially after service work has been performed on equipment anywhere in the electrical system.

Generator Set Bonding and Equipment Grounding

Bonding is defined as: (Reference National Electrical Code, 1975, Article 100) The permanent joining of metallic parts to form an electrically conductive path which will assure electrical continuity and capacity to conduct safely any current likely to be imposed.

WARNING *It is extremely important for life safety that bonding and equipment grounding be properly done. All metallic parts which could become energized under abnormal conditions must be properly grounded.*

Circuit and System Grounding

This refers to the intentional grounding of a circuit conductor or conductors. The design and installation of grounding system encompasses many considerations, such as multiple transformers, standby generators, ground fault protection, physical locations of equipment and conductors, just to mention a few.

Although the consulting engineer and installer are responsible for the design and wiring of each particular grounding application, the basic grounding requirements must conform to national and local codes.

Operation

GENERAL

ONAN SK Series electric generating sets are given a complete running test under various load conditions and are thoroughly checked before leaving the factory. Inspect your unit closely for loose or missing parts and damage which may have occurred in transit. Tighten loose parts, replace missing parts, and repair any damage before putting the set into operation.

PRESTART SERVICING

Lubrication System: The engine oil was drained prior to shipment. Fill the engine to the capacity shown with an oil that conforms to the requirements of the API (American Petroleum Institute) classification for service "SE or CC." Use an oil of the proper SAE (Society of Automotive Engineers) grade number in accordance with the recommendations for the anticipated temperature shown in Table 3 below. Fill the engine with oil until the crankcase level is at the FULL mark on the engine dipstick. Do not overfill.

Oil capacity (nominal)

Oil Pan and Filter — 6 quarts (5.7 litres)

Cooling System: The cooling system was drained prior to shipment. Fill the cooling system before starting. Nominal capacity is 18 quarts (17 litres). For radiator and city water (heat exchanger) cooled units, fill the system with clean soft water. Use a quality rust and scale inhibitor, and water pump lubricant additive. If a possibility exists of a radiator cooled set being exposed to freezing temperatures, use an anti-freeze with an ethylene-glycol base. During the initial run check coolant several times and replenish if necessary. Refer to the Chrysler manual for additional information.

CAUTION

1. Verify that the electric solenoid valve used with city water cooled sets is open before initial starting of set to allow coolant chambers to fill. Overheating and damage to the engine could result from non-compliance.

2. If engine is equipped with a cooling system filter, do not use antifreeze with an anti-leak formula. The stop leak element can prevent or retard the coolant flow through the filter, thereby eliminating the filtering process completely.

3. If the set is equipped with an engine heater do not plug in the heater until the cooling system has been filled.

WARNING

Be careful when checking coolant under pressure. It is advisable to shut engine down and bleed off pressure before removing pressure cap. Severe burns could result from contact with hot coolant.

TABLE 3. ENGINE OIL RECOMMENDATIONS

Anticipated Temperature Range	Recommended Viscosity Grade No.	Recommended Multi-Viscosity Oils
Above +32° F (0° C)	SAE 30	SAE 20W-40
As low as +10° F (-12° C)	SAE 20-W	SAE 20W-40 SAE 10W-30 SAE 10W-20
As low as -10° F (-23° C)	SAE 10-W	SAE 10W-30 SAE 10W-20 SAE 5W-20
Below -10° F (-23° C)	SAE 5-W	SAE 5W-20

Chrysler Corporation does not recommend the use of any lubricant which does not have both a SAE designation and a SE or CC service classification on the container.

Fuel: If the set uses gasoline fuel, ensure that the fuel supply tank is properly filled with automotive "regular" gasoline. Do not use highly leaded premium grade gasoline. Check with the fuel supplier for assurance that the fuel meets the specifications. Make every effort to maintain the fuel supply clean.

If the set uses gas fuels, ensure that the fuel supply is turned on. Observe safety precautions regarding the use of LP fuels as follows:

- Be sure LPG tank shut-off valve is closed before disconnecting tank from system.
- Ignition switch must be in OFF position prior to disconnecting any electrical wires.
- Check fuel system regularly for leaks. Use soap to locate leaks and recheck with soap after repairing leaks.
- Keep a fire extinguisher handy for immediate use. A dry powder or carbon dioxide (CO₂) type is recommended.
- Never use LPG for cleaning parts.
- Do not use LPG near open flame. Work in a well ventilated area.

LPG is heavier than air and settles in low places.

Combination Gas-Gasoline: A set designed for normal operation on gas fuel with the provision for emergency operation on gasoline requires adjustments to be made by the operator prior to operation.

The set is equipped with a carburetor mounted gas-gasoline toggle switch. The switch is provided by Onan to enable the operator to switch fuel stop valves for gas and gasoline in or out of the generating set control circuitry. The fuel stop valves are *not* provided by Onan.

For operation on gaseous fuel ensure that the gasoline manual shutoff valve is shut. Adjust the electric choke so the cover is turned 10 to 12 notches counterclockwise from the "•" mark. Position the fuel select toggle switch to the appropriate position.

For operation on gasoline adjust the choke so the cover is turned to the "•" mark, open the gasoline manual shutoff valve, and position the toggle switch to the gasoline position.

Check all connections and lines in the fuel system for leaks. Ensure that pressure will not bleed off when the engine is not in operation. Fuel pressure should be maintained for immediate starting if the unit is on standby service.

Battery: Verify all battery cable connections are secure. Coat connections with petroleum based or non-conductive grease to retard formation of corrosive deposits.

Check electrolyte level at the split ring mark. Measure specific gravity of the electrolyte: SG 1.260 at 80° F (27° C). If distilled water has been added or specific gravity is less than 1.260, place the battery on charge until desired reading is obtained. Do not overcharge.

STARTING

When the preceding service functions have been performed, recheck to verify unit is ready to start.

1. Crankcase filled.
2. Cooling system filled.
3. Batteries charged and connected.

To start, move the Run-Stop-Remote switch to the "Run" position. The engine should start after a few seconds of cranking. Immediately after start, observe the oil pressure gauge. Normal oil pressure is between 30 and 55 psi (207 and 379 kPa). Check the following gauges:

1. DC Ammeter—10 to 30 amperes.
2. AC Voltmeter—AC generator output voltage.
3. Frequency Meter—AC generator output frequency.

After running 10 minutes under load the water temperature gauge should have stabilized at 180° to 205° F (82° to 96° C). On city water cooled units an adjustable valve is connected in the water supply line. Adjust the hand wheel valve to provide a water flow that will keep the water temperature gauge reading within the range of 165° F to 205° F (74° C to 96° C).

Break-In Note: Run set at 50 percent rated load for the first half-hour of initial operation after reaching operating temperature.

Non-Start: If after a few seconds of cranking engine fails to start, or starts and runs then stops and fault lamp lights, refer to appropriate troubleshooting chart, Table 4 or Table 5.

STOPPING

To reduce and stabilize engine temperatures, run the engine at no load for three to five minutes before shutting down.

Move the Run-Stop-Remote switch to "Stop" position to shut down the set.

NO LOAD OPERATION

Periods of no load operation should be held to a minimum. If it is necessary to keep the engine running for long periods of time when no electric output is required, best engine performance will be obtained by connecting a "dummy" electrical load. Such a load could consist of heater elements, etc.

EXERCISE PERIOD

Generator sets on continuous standby service are required to be operative at essential loads from a cold start in a short period of time in the event of a power outage.

This imposes severe conditions on the engine. Friction of dry piston rings upon dry cylinder walls causes scuffing and rapid wearing. These can be relieved by exercising the set at least once a week for a minimum time of 30 minutes per exercise period. Preferably, run the set under at least 50 percent load to allow the engine to reach normal operating temperature. This will keep engine parts lubricated, maintain fuel prime, prevent electrical relay contacts from oxidizing and insure easy emergency starts. ONAN automatic transfer switches contain an optional exercise switch which, by pre-selection, will start, determine run period and shut down a set on a weekly frequency. For example, the switch can be set for time of start, length of run, A.M. or P.M. and day of week.

After each exercise period, top up fuel tank, check engine for leaks and unit for general condition. Locate cause of leaks (if any) and correct.

HIGH ALTITUDE

Ratings apply to altitudes up to 1000 feet (305 m) standard cooling, normal ambients and specified fuels. Consult factory or nearest authorized Onan distributor for operating characteristics under other conditions.

Engine horsepower loss is approximately 3 percent for each 1000 feet (305 m) of altitude above sea level for a naturally aspirated engine. Use lower power requirement at high altitudes to prevent smoke, over-fueling and high temperatures.

HIGH TEMPERATURES

1. See that nothing obstructs air flow to-and-from the set.
2. Keep cooling system clean.
3. Use correct SAE No. oil for temperature conditions.

LOW TEMPERATURES

1. Use correct SAE No. oil for temperature conditions. Change oil only when engine is warm.
2. Use fresh fuel. Protect against moisture condensation.
3. Keep fuel system clean and batteries in a well charged condition.
4. Partially restrict cool air flow but use care to avoid overheating.
5. Connect water jacket heater when set is not running.
6. Refer to Chrysler manual for further information.

OUT OF SERVICE PROTECTION

For storage of all durations, refer to the Chrysler engine manual.

BATTERY, HOT LOCATION

Batteries will self discharge rapidly if installed where ambient temperatures are consistently above 90°F (32°C). To lengthen battery life, dilute the electrolyte from its normal 1.260 specific gravity at full charge to a 1.225 reading. The engine cranking power is slightly reduced when the electrolyte is diluted, but if the ambient temperature is above 90°F (32°C), this should not be noticed. The extended battery life will be worth the effort.

WARNING

Do not smoke while servicing batteries. Explosive gases are emitted from batteries in operation. Ignition of these gases can cause severe personal injury.

1. Fully charge the battery.
2. With the battery still on charge, draw off the electrolyte above the plates in each cell. DO NOT ATTEMPT TO POUR OFF; use a hydrometer or filler bulb and dispose of the acidic electrolyte in a safe manner. Avoid skin or clothing contact with the electrolyte.
3. Refill each cell with distilled water to the normal level.
4. Continue charging for 1 hour at a 4-6 ampere rate.
5. Test each cell. If the specific gravity is still above 1.225, repeat steps 2,3 and 4 until the reading is reduced to 1.225. Usually repeating steps twice is sufficient.

TABLE 4.
TROUBLESHOOTING ENGINE SHUTDOWN SYSTEM
(Engines with only one fault lamp)

SYMPTOM	CORRECTIVE ACTION
1. Engine stops cranking and fault lamp lights after cranking approximately 75 seconds. Overcrank diagnostic LED lit.	1. Check fuel supply. See engine service manual for troubleshooting fuel and ignition systems.
2. Fault lamp lights immediately after engine starts. None of the diagnostic LED'S illuminated.	2. Check for overspeed condition as the engine starts.
3. Fault lamp lights and engine shutdown after running for a period. Check for lighted diagnostic LED'S.	3. Observe and check the following: a. Low Oil Pressure LED lit; check oil level, engine will shutdown if sensor is closed. Check Chrysler manual for troubleshooting oil system. b. High Engine Temperature LED lit; check coolant level, coolant flow, (city water cooled systems), check radiator for free air flow, fan belts for tightness. See engine manual for troubleshooting cooling system. c. Check for faulty oil pressure or high engine temperature sensor.
4. Fault lamp lights, none of the diagnostic LED'S lit, no fault exists.	4. Disconnect leads from TB11 terminals 29, 30, and 31. If fault lamp lights with leads disconnected and no diagnostic LED'S are lit, replace engine monitor board. Reconnect leads.

TABLE 5.
TROUBLESHOOTING ENGINE SHUTDOWN SYSTEM
(Units with five fault lamps)

SYMPTOM	CORRECTIVE ACTION
1. Overcrank fault lamp lights and engine stops cranking after approximately 75-seconds.	1. See engine service manual for troubleshooting fuel system, ignition system, etc.
2. Engine runs, shuts down, cranks for 75-seconds, cranking cycle stops, overcrank light ON.	2. Check fuel supply, check ignition.
3. Low oil pressure shutdown.	3. Check — a. Oil level. Replenish if necessary. b. Sensor. Faulty sensor will shut down engine. c. Refer to engine service manual for troubleshooting guide for oil system.
4. High engine temperature shutdown.	4. Check— a. Coolant level. Replenish if necessary. b. City water cooled sets. Check water flow, valves, etc. c. Check sensor; check thermostat. d. Radiator model, check fan belts, radiator for obstructions, etc.
5. Overspeed shutdown.	5. Check governor and throttle linkages for freedom of movement.
6. Low oil pressure light ON. No shutdown.	6. Disconnect wire at TB11-30. Light ON after relay reset. Replace engine monitor board.
7. High engine temperature light ON. No shutdown.	7. Disconnect wire at TB11-31. Light ON after relay reset. Replace engine monitor board.

Maintenance

GENERAL

Establish and adhere to a definite schedule of maintenance inspection and servicing. Application and environment are the governing factors in determining such a schedule. If set is a prime power application, base the schedule on operating hours. Use the running time meter to log hours run; maintain an accurate record of hours and service for warranty support. Table 6 lists the maintenance items and service schedule.

A set on standby duty will need servicing at times other than those recommended by ONAN and Chrysler. Refer to the Chrysler manual for engine services and maintenance procedures. Adjust your schedule to satisfy the following conditions:

- Continuous duty (prime power)
- Standby power

- Ambient temperature extremes
- Exposure to the elements
- Exposure to salt water or sea air
- Exposure to dust, sand, etc.

Consult with your ONAN distributor or dealer for a schedule of maintenance and service more suitable to the unique environment and application of your set.

WARNING

Before commencing any maintenance work on the engine, generator, control panel, automatic transfer switch or associated wiring, disconnect batteries. Failure to do so could result in damage to the unit or serious personal injury in the event of inadvertent starting.

TABLE 6. OPERATOR MAINTENANCE SCHEDULE

MAINTENANCE ITEMS	OPERATIONAL HOURS					
	10	50	200	250	400	500
Inspect Complete Set for Leaks—exhaust, coolant, oil, etc.	x1					
Check Engine Oil Level	x1					
Check Radiator Coolant Level	x1					
Check Fuel	x1					
Check Governor Oil Level		x				
Clean Carburetor and Crankcase Ventilation Air Cleaners		x2				
Check Electrolyte Level of Battery		x6				
Lubricate Governor Linkage		x2				
Change Engine Oil & Filter		x2				
Check all Hardware, Fittings, Clamps, Fasteners, etc.		x4				
Adjust Drive Belt Tension			x3			
Change Governor Oil			x			
Clean Fuel Lift Pump			x			
Change Fuel Filter			x			
Check Starter			x5			
Clean Battery Terminals. Coat With Non-Conductive Grease			x			
Check AC Generator			x			
Inspect Spark Plugs. Replace if Necessary			x			
Replace Fuel Filter Element				x2		
Adjust Valve Clearances					x	
Inspect Ignition Points. Replace if Necessary (sets with points)				x		
Check Crankcase PCV Valve for Proper Operation			x			
Adjust Drive Belts		x				
Lubricate Distributor Cam				x		
Check Carburetor Adjustment				x		
Clean Engine Thoroughly				x		
Replace Crankcase Ventilator Valve						x
Replace Carburetor Air Cleaner Element						x

- x1 - As noted or after every run. Check exhaust system visibly and audibly for leaks.
 x2 - Perform more often in extremely dusty conditions.
 x3 - Adjust to 1/2-inch (13 mm) depression between pulleys. Refer to engine manual.
 x4 - Or every 3 months.
 x5 - Oil front bearing sparingly; check brushes.
 x6 - Or every two weeks.

NOTE: The above schedule is a minimum requirement.

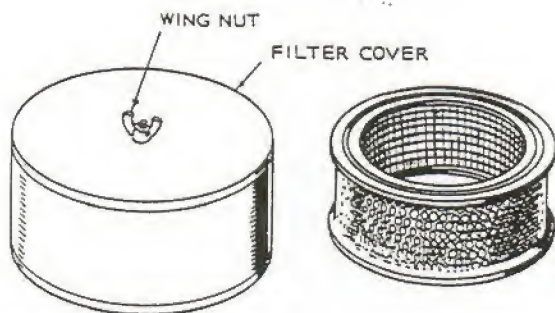
ENGINE

General: Basic maintenance procedures are contained within the Chrysler manual, which should be used in conjunction with the set manual, except in such cases where instructions state otherwise. Then, the new information unique to the SK set shall take precedence.

Air Filter: Remove wing nut in center of filter cover. Remove cover and filter (Figure 17). Tap filter on a flat surface to remove adherent dirt. Place a light source inside the filter and inspect for free air passage. If necessary, apply a low pressure air source (30-psi [207 kPa] OSHA) to the inside of the filter to remove as much dirt as possible. Inspect interior housing. Vacuum clean if dirty, or remove housing and wipe clean.

CAUTION Do not clean filter housing while still installed. Loose dirt entering intake could damage carburetor or engine.

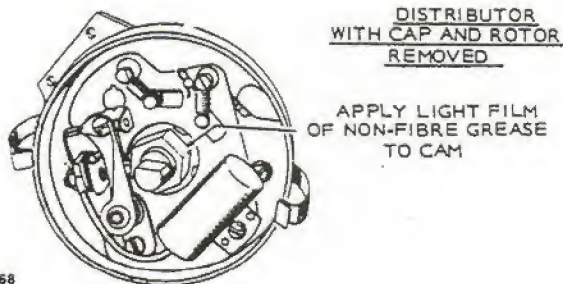
Replace air filter every 50 hours of operational time; more often in extremely dusty conditions.



EXS-1048

FIGURE 17. AIR CLEANER

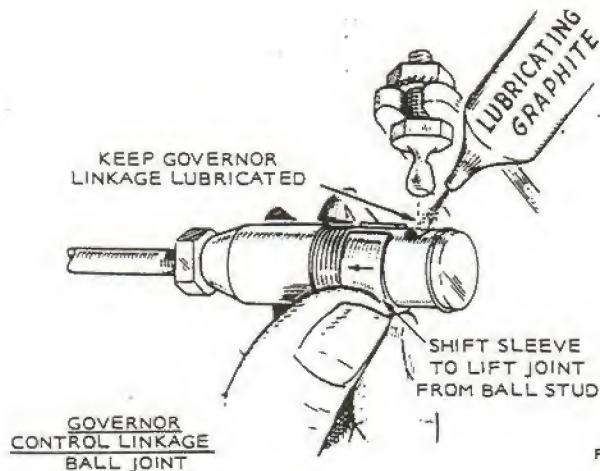
Distributor Cam: After every 250 hours of operation, wipe old grease from surfaces of the breaker cam. Apply a light film of non-fibre distributor cam grease to area shown in Figure 18.



ES-1168

FIGURE 18. DISTRIBUTOR CAM

Governor Ball Joint: The control linkage ball joint should be kept lubricated with graphite. If the ball joint is neoprene, do not lubricate. Keep linkage free of dust and grease. See Figure 19.



FS-1254

FIGURE 19. GOVERNOR BALL JOINT

Engine Oil Filter: Spin-off type, should be replaced with every oil change, at 50 hours of operational time. See Figure 20.



LS-1056

FIGURE 20. OIL FILTER ASSEMBLY

Remove and discard oil filter, wipe oil from exposed adapter recess. Coat gasket of new filter with clean lubricating oil and place in position on adapter. Hand-tighten filter until gasket contacts adapter face then advance one-half turn. DO NOT OVERTIGHTEN.

Clean all oil residues from engine, then fill crankcase. Refer to *Prestart Servicing*. Run engine and check for oil leaks; make necessary repairs. Note oil change in engine logbook.

Fuel Filter: One piece in-line filter, should be replaced after every 200 hours of operation. See Figure 21.

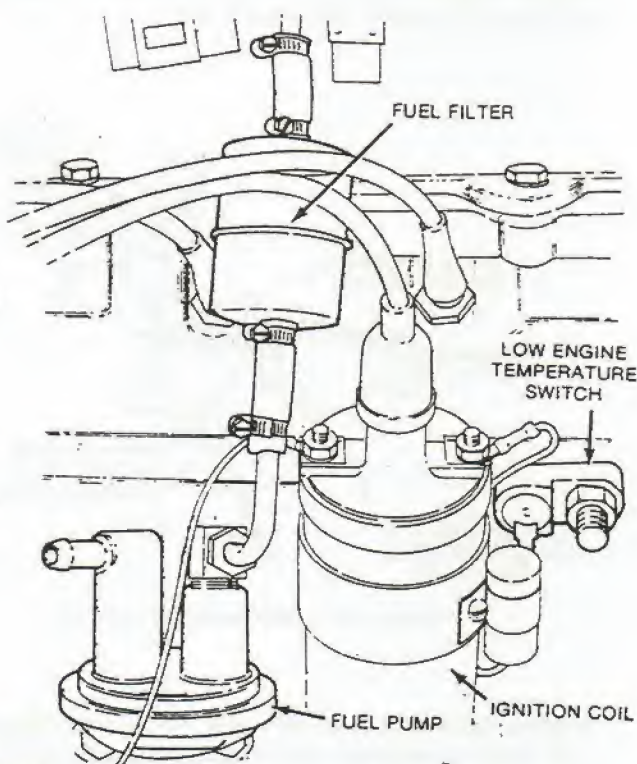


FIGURE 21. FUEL FILTER

Crankcase Inlet Air Cleaner: Disconnect the hose from the air cleaner. Inspect the hose and clean if necessary. Remove the air cleaner and wash it thoroughly in kerosene or similar solvent. Invert the crankcase air cleaner and fill with SAE 30 engine oil to wet the filter. Drain the excess oil completely through the vent nipple on the top of the air cleaner. Reinstall the air cleaner and hose. Record the filter cleaning in the engine logbook.

Crankcase Ventilation Valve (PCV Valve): With the engine idling remove the ventilator valve from the rocker cover. If the valve is operating properly a hissing noise will be heard when air passes through the valve. A strong vacuum should be felt when a finger is placed over the valve inlet.

Reinstall the ventilator valve, then remove the crankcase inlet air cleaner. Hold a piece of stiff paper over the hole in the rocker arm cover; if the paper is held loosely about a minute, after the crankcase pressure has been reduced, the paper should be drawn in against the opening in the cover with significant force.

With the engine stopped remove the ventilator valve from the rocker cover and shake it. A clicking sound indicates that the valve mechanism is free.

If any of the above procedures indicate a plugged or faulty valve replace the ventilator valve.

If a new valve is installed and the paper is not drawn in against the opening in the rocker cover with significant force it will be necessary to clean the ventilator hose. Refer to the Chrysler engine manual for procedures.

Carburetors

The following safety precautions must be observed when working with LPG:

- Be sure LPG tank shut-off valve is closed before disconnecting tank from system.
- Ignition switch must be in OFF position prior to disconnecting any electrical wires.
- Check fuel system regularly for leaks. Use soap to locate leaks and recheck with soap after repairing leaks.
- Keep a fire extinguisher handy for immediate use. A dry powder or carbon dioxide (CO₂) type is recommended.
- Never use LPG for cleaning parts.
- Do not use LPG near open flame. Work in a well ventilated area.

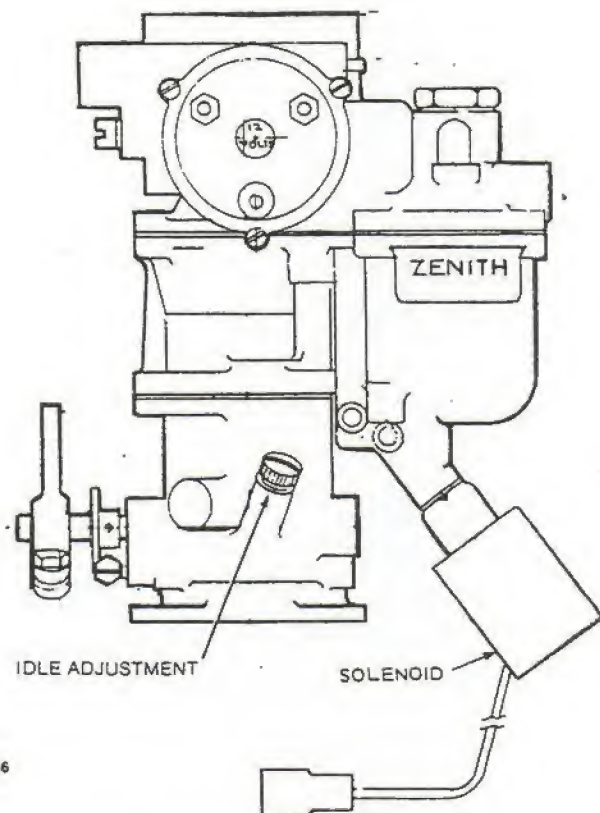
LPG is heavier than air and settles in low places.

The following carburetors were installed by ONAN for a specific application and engine output. Use these instructions and adjustment procedures in preference to those given in the Chrysler engine manual.

Carburetor, Gasoline: Carburetors have fixed main jets and an adjustable idle circuit. The idle adjusting needle, at the side of the carburetor, affects operation at no load and light load conditions (Figure 22).

Under normal circumstances, factory carburetor adjustments should not be disturbed. If adjustments have been changed, an approximate setting of 1-1/2 turns open for the idle needle will permit starting of the engine. Adjust temporarily for smoothest running. Allow engine to thoroughly warm up before making final adjustment.

To adjust "idle" (no load) needle see that no loads are connected to the generator. Slowly turn idle adjusting needle out until engine speed drops slightly. Turn needle in just to the point where speed returns to normal.



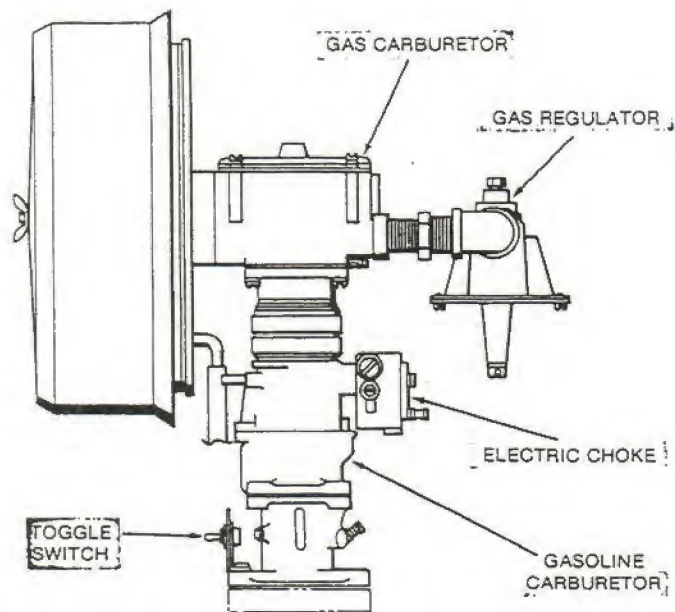
FS-1256

FIGURE 22. GASOLINE CARBURETOR

Combination Carburetor, Gas Operation: If the engine is equipped with a combination carburetor ensure the manual gasoline shutoff valve is closed and the fuel toggle switch is in the gas position (Figure 23). The electric choke must be adjusted so the cover is turned 10 to 12 notches counterclockwise from the "*" mark. When properly adjusted the electric choke will be completely open even at very low temperatures. See paragraph on "Electric Choke."

Gas fuel main jet adjustment should be made at full load only.

To adjust main needle, apply a full electrical load. Turn the main needle in until engine speed begins to drop. Slowly turn needle out until speed no longer rises. Try various electrical loads. If engine speed fluctuates at any load, turn main adjusting needle out slightly. Do not turn out more than 1/2 turn beyond original full load setting. If stable speed cannot be obtained by such carburetor adjustment, a change in governor sensitivity adjustment will probably be necessary.



FS-1257

FIGURE 23. COMBINATION CARBURETOR

Carburetor, Gas: Engines equipped for natural gas operation use a gas carburetor with combined regulator. Carburetor adjustments are the same as the combination gas-gasoline carburetor.

Conversion kits are available for LPG operation. Contact your local Onan representative for information. Give complete Model, Spec No. and Serial No. of set when requesting conversion information.

Electric Choke: A 12 volt electric choke with vacuum booster is used on all engines. The adjustable choke cover is held in place by three screws (Figure 24). Perimeter of the cover is divided into sections by small raised marks. One mark is labeled zero and the twelfth mark from zero is labeled with an asterisk (*), which indicates normal adjustment setting. A long raised line on top of the choke housing is used as the reference mark. Normal setting for the choke when running on gasoline is made when the asterisk mark lines up with reference line. Normal gaseous fuel setting is 10 to 12 notches counterclockwise from the asterisk mark.

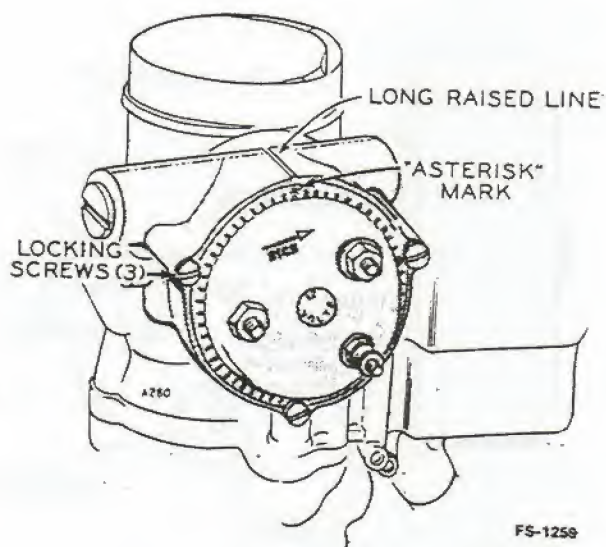


FIGURE 24. ELECTRIC CHOKE

Governor

The governor controls the speed of the engine, and therefore the generator output frequency (Figure 25). Engine speed also affects AC output voltage. Use either a tachometer or frequency meter to check engine speed for proper governor adjustment.

1. Governor linkage- With the engine stopped, throttle held wide open, and tension on the governor spring, adjust the governor linkage length by rotating the ball joint on the link so the throttle stop lever clears the stop pin by not less than 1/32 inch (.786 mm).
2. Warm up- Start the engine and allow it to reach normal operating temperature.
3. Speed- With no electrical load connected, adjust the speed adjusting screw to obtain 1890 r/min (63 hertz). Apply a full electrical load. The speed drop from no load to full load should be no more than 90 r/min (3 hertz) and no less than 60 r/min (2 hertz). An incorrect speed drop from no load to full load necessitates a sensitivity adjustment.
4. Sensitivity- If the engine tends to hunt under load conditions, increase the sensitivity screw on which the spring link pivots. Any change in the setting of the sensitivity screw will require correcting the speed screw adjustment. Increasing the sensitivity causes a slight speed increase which can be compensated for by turning the speed screw slightly counterclockwise to decrease spring tension.
5. General- Ensure all lock nuts are tightened as adjustments are completed. Governors cannot operate properly if there is binding, sticking, or excessive looseness in the connecting linkage or carburetor throttle assembly. A lean fuel mixture or a cold engine may cause hunting.

6. Output- Check the AC output voltage.
7. Throttle Stop- With the engine stopped, see that the throttle stop lever screw engages the carburetor throttle stop pin by 1/4 to 1/2 turn. This can be done by backing off the screw until it just clears the stop pin, then turning in 1/4 to 1/2 turn. This provides a cracked open throttle for good starting characteristics. Do not adjust the screw so far as to cause the engine to diesel and refuse to stop.

Governor oil level should be even with bottom of the oil level plug. When adding oil to the governor, the oil should just start to flow out of the oil level plug hole. Do not overfill. Use a good grade engine oil of 10W-30 multi-viscosity.

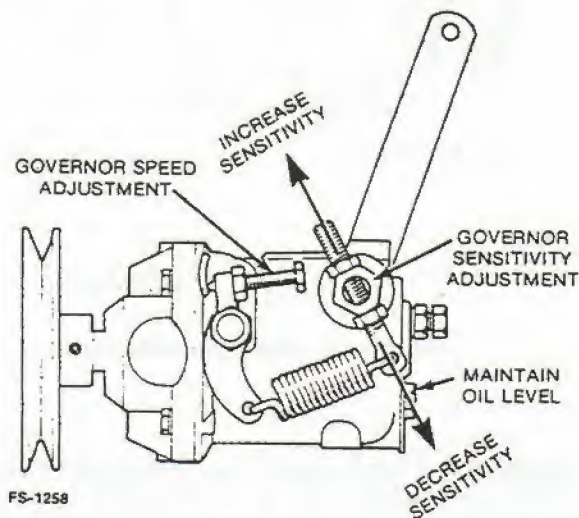


FIGURE 25. GOVERNOR

Drive Belt Adjustment: The alternator and fan are driven by the same belt. Separate belts are used to drive the governor and water pump. The water pump drive belt uses an idler pulley assembly to ease in belt adjustments. Maintain correct adjustment of these belts to provide proper engine cooling and alternator output. Check belts for cracks and wear occasionally, and replace when necessary.

To adjust alternator or governor belt, loosen link clamp screw and the mounting bolts. Move the alternator or governor toward or away from engine until a 1/2 inch (13 mm) deflection between the pulleys is obtained with a light pressure on the belt. Ensure link clamp screw and mounting bolts are securely retightened after adjustment is completed.

To adjust the water pump belt loosen the adjustment bolts on the idler assembly and move the assembly up or down until a 1/2 inch (13 mm) deflection is obtained. Ensure adjustment bolts are securely retightened after the adjustment is completed.

Connections (Fuel, Exhaust, etc.)

Operator should periodically make a complete visual inspection of the unit while running at rated load.

Some of the things to check for are as follows:

1. Check fuel and oil lines for possible leakage.
2. Inspect exhaust lines and mufflers for possible leakage and cracks.
3. Periodically or daily drain moisture from condensation traps.
4. Inspect water lines and connections for leaks and security.
5. Inspect electrical wires for security.

Tank Heaters (Optional)

A Kim Tank Heater (Figure 26) is optional equipment on the SK generator set. For efficient operation and optimum product life, perform the following procedure at least once a year.

1. Remove head and valve assembly.
2. Clean foreign matter out of the tank.
3. Remove element and scrape off scale accumulated on the sheathing.

CAUTION When reassembling threaded aluminum parts, be sure to use anti-seize compound.

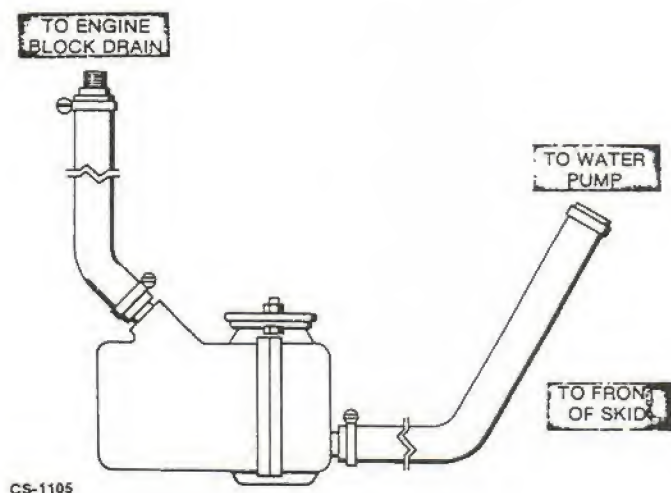


FIGURE 26. TANK HEATER

Battery

Check the condition of the starting battery at least every two weeks. Ensure that the connections are snug and clean. A light coating of grease will retard corrosion at the terminals. Keep the electrolyte at the proper level above the plates by adding distilled water.

WARNING Do not smoke while servicing batteries. Explosive gases are emitted from batteries in operation. Ignition of these gases can cause severe personal injury.

Tune Up

ONAN suggests that the following specifications for tune up be used in preference to those given in the Chrysler engine manual.

Spark Plug Gap	0.035 in. (0.89 mm)
Ignition Points Gap	0.017-0.023 in. (0.43-0.58 mm)
Dwell Angle	40° - 45°
Valve Clearance	
Intake (Hot)	0.012 in. (0.30 mm)
Exhaust (Hot)	0.024 in. (0.61 mm)

AC GENERATOR

There are no brushes, brush springs or collector rings on these generators, therefore they require very little servicing. Periodic inspections, to coincide with engine oil changes, will ensure good performance.

Inspection: Inspect generator and control box for loose or broken wires and parts. Check diodes and printed circuit boards for excessive dust, grease or moisture. Blow these assemblies out periodically with filtered, low pressure, compressed air.

CAUTION Excessive foreign matter on diodes and heat sinks will cause overheating and possible failure.

Generator Bearing

Inspect the bearing for evidence of outer case rotation every 1000 hours while the unit is running.

If unit is used for "prime power," replace the bearing every 10,000 hours or two years. If the unit is used for "standby," replace the bearing every five years.

Deterioration of the bearing grease due to oxidation makes this replacement necessary.

If generator requires major repair or servicing, contact an authorized Onan dealer or distributor.

